SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

19MET202 – MANUFACTURING TECHNOLOGY

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UNIT-2
METAL FORMING AND SHEET METAL PROCESSES

Mechanical working of Metals- Plastic deformation theory – Principles - Hot working and cold working of metals: Forging-Types - Operations, rolling – Flat and Shape rolling, Extrusion – Direct & Indirect, Drawing processes – Tube, Wire - Defects. Sheet metal Processes and characteristics–shearing - bending and drawing operations. special forming Processes : Types - Rubber pad forming - Explosive forming - peen Forming.

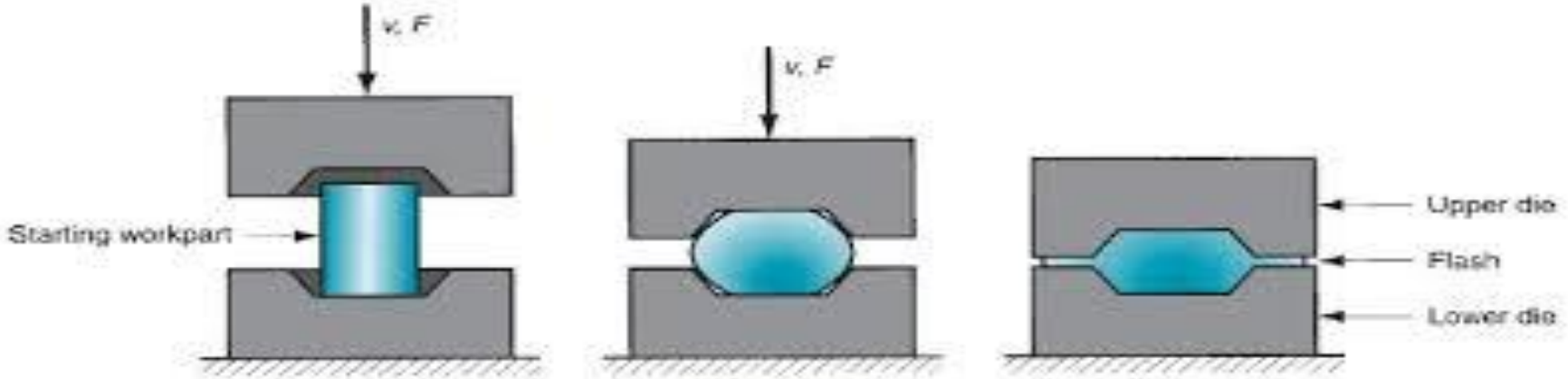
UNIT-2, LESSON-1

MECHANICAL WORKING OF METALS, PLASTIC DEFORMATION THEORY & PRINCIPLES

MECHANICAL WORKING OF METALS

Mechanical working is a process of shaping of metals by plastic deformation. When a metal is subjected to external force beyond yield strength but less than fracture strength of the metal, metal is deformed by slip or twin formation.

 The wastage of material in metal working process is negligible or very small. But the production is very high compared to other process.



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MECHANICAL WORKING OF METALS

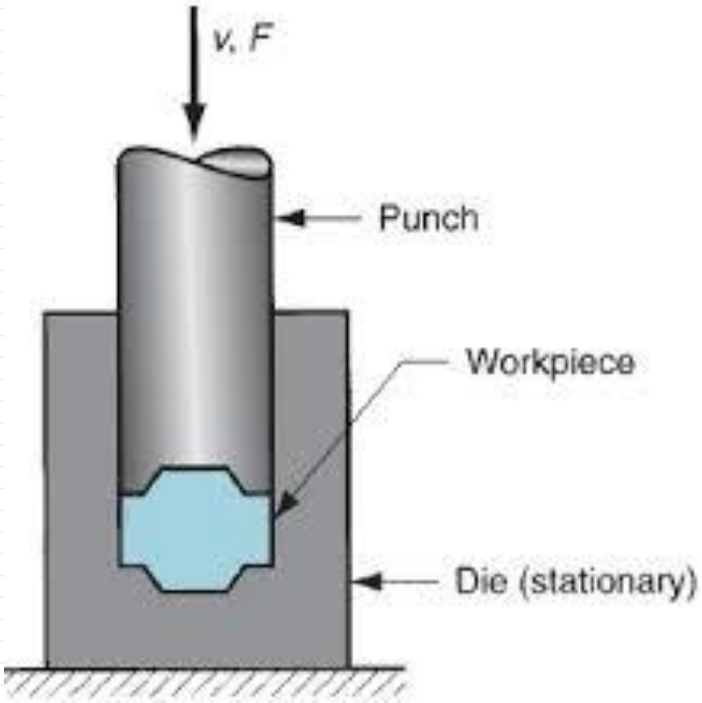
Types of Metal Working or Processing Methods :

- Mechanical processing
  - Hot working
  - Cold working

- Thermal processing
  - Annealing
    - Recovery, re-crystallization and growth
  - Heat treatments
- Both of these are used to control properties of the final product

MECHANICAL WORKING OF METALS

Mechanical Working is the process of deformation of metals under complex stress systems. The behavior of metal under compressive stress is more complex. This can be seen from an analysis of what happens when a cylindrical sample is compressed between two platens. Plastic deformation commences when the stress on the work piece attains the yield stress of the metal. As the height of the sample decreases, it spreads outwards with an increase of cross-sectional area.



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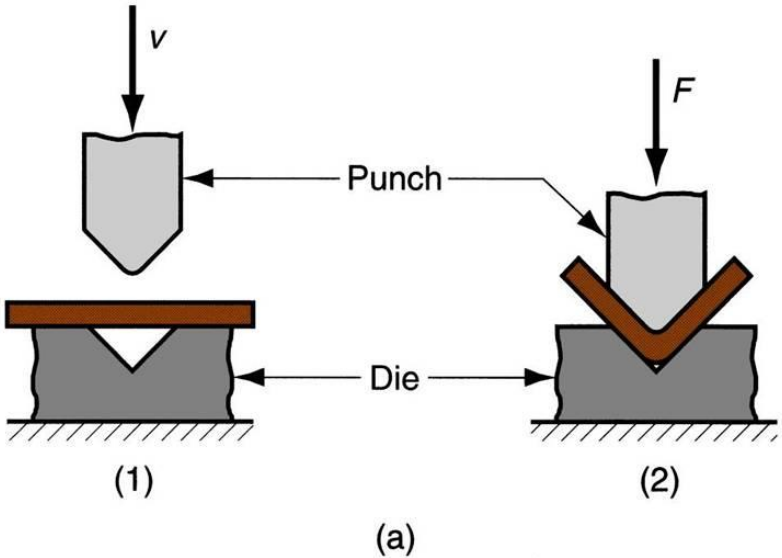
MECHANICAL WORKING OF METALS

This movement takes place against a frictional force between the ends of the work piece and the platens. The deforming metal is subject to the complex stress system. The stress system has altered from single, uni-axial to three-dimensional or tri-axial. There is one applied stress from the platens and two are induced by the friction reaction. The presence of friction results in a higher stress to cause yielding.



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PLASTIC DEFORMATION THEORY AND PRINCIPLES

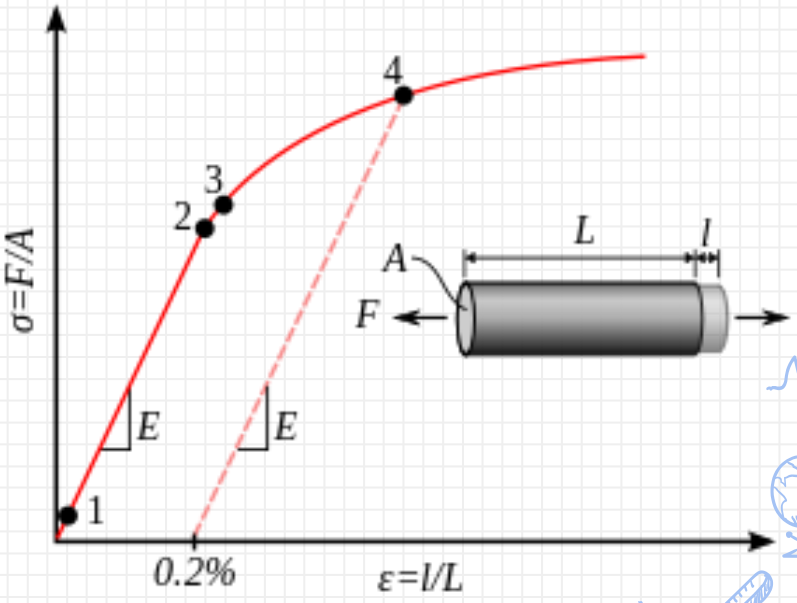
Plastic deformation

• If the solid body is loaded beyond the elastic limit, the body will experience a permanent change in shape and size, even if the load is removed .

• Plastic deformation of metals and alloys is generally studied under two categories namely,

i. Plastic deformation of single crystals.

ii. Plastic deformation of polycrystalline materials



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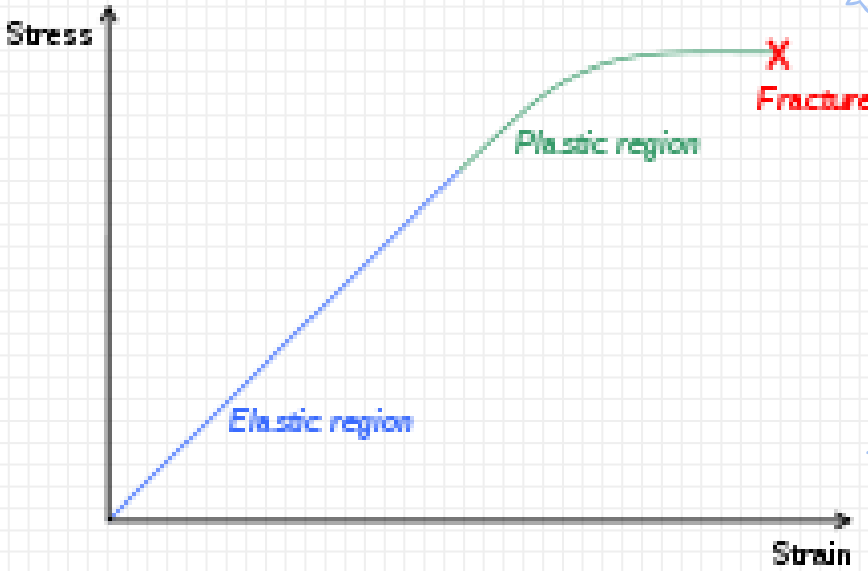
PLASTIC DEFORMATION THEORY AND PRINCIPLES

Plastic deformation of single crystals involve the study of one single crystal and observing how it behaves under stress.

- A single crystal is nothing but a single grain and has no grain boundaries.
- Plastic deformation in single crystals may take place by i. Slip ii. Twinning or iii. a combination of both



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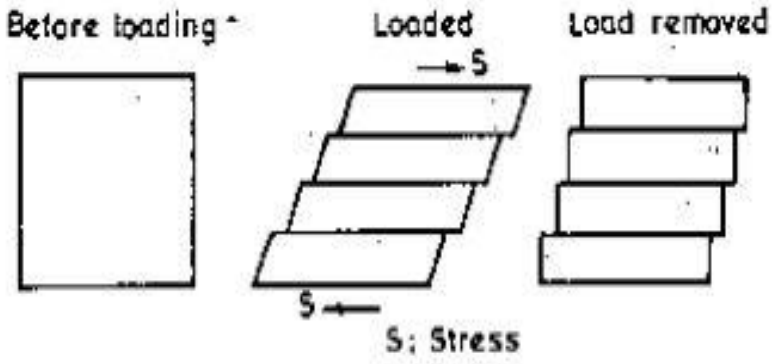
PLASTIC DEFORMATION THEORY AND PRINCIPLES

Plastic deformation by slip

• Slip is the most common mode of plastic deformation among crystals.

• When a single crystal in tension is stressed beyond its elastic limit, a step appears such that the single crystal divides into two blocks

. • When the tensile load is further increased, the blocks become again divided and relative displacement takes place.



Plastic Deformation.

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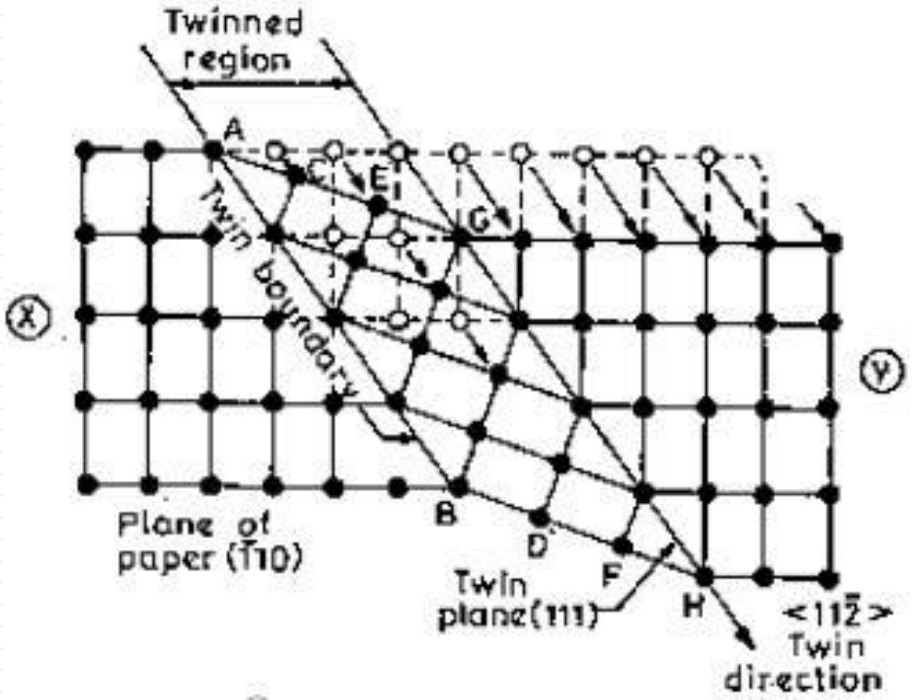
PLASTIC DEFORMATION THEORY AND PRINCIPLES

Plastic deformation by twinning

- In twinning each plane of atoms move through a definite distance and in the same direction.
- The extent of movement of each plane is proportional to its distance from the twinning plane.



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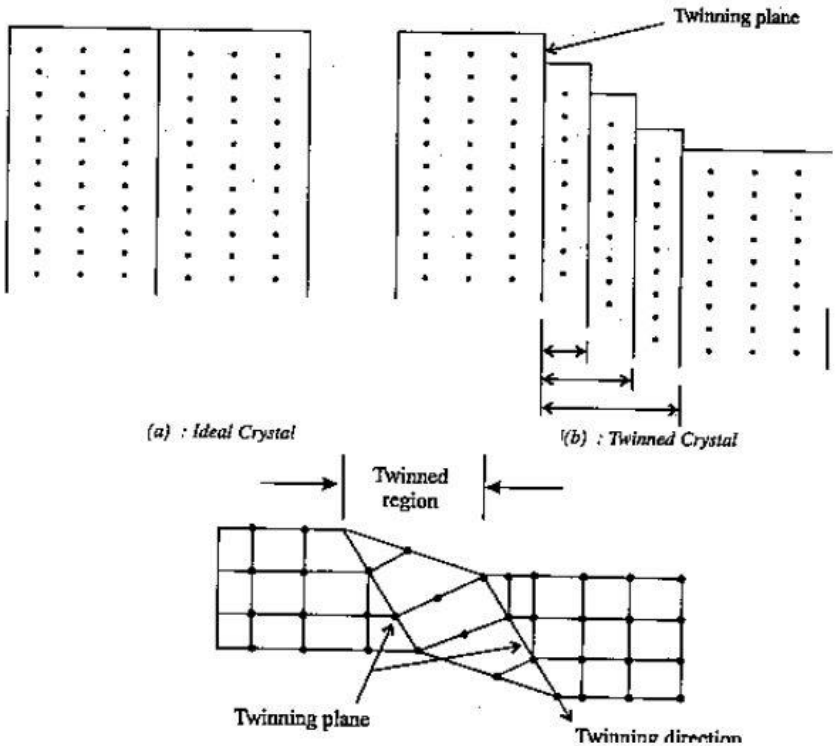
PLASTIC DEFORMATION THEORY AND PRINCIPLES

- When a shear stress is applied, the crystal will twin about the twinning plane in such a way that the region to the left of the twinning plane is not deformed whereas the region to the right is deformed.
- The atomic arrangement on either side of the twinned plane is in such a way that they are mirror reflections of each other.



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PLASTIC DEFORMATION THEORY AND PRINCIPLES

Slip	Twinning
1. All atoms in one block move over the same distance	1. Different planes of atoms moves fractional distances depending on their distance from the twinning plane.
2. Under microscope, slip appears as thin line.	2, It appears as broad lines (or) bands.
3. There is very little change in lattice orientation.	3. Lattice orientation changes in the twinned regions.
4. It requires lower shear stress.	4. It requires higher shear stress.
5. Occurs in metals having more number of slip systems.	5. Occurs in metals having less number of slip systems.

ASSESSMENT

1. Forming is a process that changes the shape of the metal by changing its phase.
   a) True
   b) False
2. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.
   a) True
   b) False
3. Which of the following processes is not the type of metal forming process?
   a) Extrusion
   b) Injection molding
   c) Forging
   d) Drawing

ASSESSMENT

4. The process of increasing strength of a material by changing grain size known as _____

a) Grain boundary strengthening
b) Work hardening
c) Solid solution hardening
d) Precipitation hardening

5. Iron base alloys have melting point around _____

a) 900^{o}C
b) 1500^{o}C
c) 1900^{o}C
d) 2400^{o}C

THANK YOU